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Capsule Performance Optimization for the National Ignition Facility

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The overall goal of the capsule performance optimization campaign is to maximize the probability of ignition by experimentally correcting for likely residual uncertainties in the implosion and hohlraum physics used in our radiation-hydrodynamic computational models before proceeding to cryogenic-layered implosions and ignition attempts. This will be accomplished using a variety of targets that will set key laser, hohlraum and capsule parameters to maximize ignition capsule implosion velocity, while minimizing fuel adiabat, core shape asymmetry and ablator-fuel mix. The targets include high Z re-emission spheres setting foot symmetry through foot cone power balance [1], liquid Deuterium-filled "keyhole" targets setting shock speed and timing through the laser power profile [2], symmetry capsules setting peak cone power balance and hohlraum length [3], and streaked x-ray backlit imploding capsules setting ablator thickness [4]. We will show how results from successful tuning technique demonstration shots performed at the Omega facility under scaled hohlraum and capsule conditions relevant to the ignition design meet the required sensitivity and accuracy. We will also present estimates of all expected random and systematic uncertainties in setting the key ignition laser and target parameters due to residual measurement, calibration, cross-coupling, surrogacy, and scale-up errors, and show that these get reduced after a number of shots and iterations to meet an acceptable level of residual uncertainty. Finally, we will present results from upcoming tuning technique validation shots performed at NIF at near full-scale. Prepared by LLNL under Contract DE-AC52-07NA27344.

[1] E. Dewald, et. al. Rev. Sci. Instrum. 79 (2008) 10E903.
[2] T.R. Boehly, et. al., Phys. Plasmas 16 (2009) 056302.
[3] G. Kyrala, et. al., BAPS 53 (2008) 247.
[4] D. Hicks, et. al., BAPS 53 (2008) 2.